

THE MODEL ENGINEER

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Smoke Rings

Stay-at-home Holidays

THE brightly-written news sheet of the Malden Society tells me that the members have under consideration the installation and running of a passenger-carrying track in Beverley Park during the summer months, as a contribution towards the enjoyment of the members and the public during the "stay-at-home holidays" which so many people are adopting this year. This is an idea which might well be considered in other localities. A passenger-carrying model railway is always a source of great local interest and of enjoyment for the younger generation, and would form a very popular addition to the entertainment amenities of public parks or recreation grounds.

Fuel Economy in the Home Workshop

THE urgent need for economy of fuel in all its forms of light, heat, and power will be fully recognised by model engineers. Not only will it affect the domestic requirements in their homes and the needs for such industrial activities in which they may be engaged, but it will apply equally to the consumption of fuel in the model engineering workshop. Many such workshops use electricity or gas, or perhaps both, for power, lighting and heating, and the quantity, modest though it may be in comparison with larger establishments, has a direct effect on the consumption of coal at the power generating station or gasworks. Although a definite rationing scheme has not been imposed at the time of writing, such a form of restriction is imminent, and it behoves all model engineers to effect such economies in their workshops as may be possible, without delay. Obvious methods of saving are to restrict the running of lathes or power-driven tools to such moments as the tools are actually in use, to switch on lights only at such places in the workshop where illumination is essential, and to keep gas stoves or burners alight only for the duration of the particular job in hand. It may be possible with some lathes or small machine tools to disconnect the electric motor and revert to treadle or hand-power

drive. The extra physical exertion required may not be altogether a disadvantage, although perhaps involving some diminution in personal comfort. The job may be accomplished a little more slowly, but that is of no particular moment. Some re-arrangement of circuits or switches may be called for, and possibly some moving of tools or benches nearer to windows where daylight can be enjoyed may be feasible. During the summer months, the lighting question is not likely to cause much difficulty, but in the dark evenings of the winter it may be worth considering whether the model engineer might not be permitted to invade the domestic preserves and carry on with some, if not all, of his work sharing the family light and warmth. I have heard of lathes being set up in a drawing-room without undue embarrassment, while numerous cases are within my knowledge where a well-equipped work-bench has been installed in one, or other of the living-rooms, and much excellent construction work has been done in these surroundings without jeopardising the family peace of mind.

Chronometers for the Navy

MR. A. J. R. LAMB, the Honorary Treasurer of the London Society, tells me that he is collecting for a fund for purchasing and presenting chronometers to the Navy. A complete instrument costs £36 free of purchase tax, and the donor of that sum will have his name engraved on a plate to be affixed to the chronometer. He will also be informed of the name of the ship to which his instrument is being presented. The London Society is considering the purchase of a complete chronometer. Mr. Lamb would be pleased to hear from any "M.E." readers who would like to contribute to such a fund. His address is Hurst Lodge, 16, Harlaxton Drive, Nottingham.

Percival Marshall

A Double-Cylinder Vertical Engine

By P. W. WILSON

THE two photographs reproduced on the next page represent a model engine which was started several years ago and which is now nearing completion.

Readers of THE MODEL ENGINEER will recall Mr. Maskelyne's articles of some years ago, describing a double-cylinder vertical engine, only built differently, my idea being to use only *one* eccentric sheave, instead of four.

Not New

Of course, this idea is not new, as we have long had with us Hackworth's, Marshall's, Joy's, Bremme's, and other types of radial valve-gears, but the idea of making a double-cylinder *model engine*, actuated by only one eccentric and to work in both directions, struck me as something out of the common.

The engine has been tried out and it works quite all right in both directions.

The cylinders are $\frac{3}{4}$ in. \times $\frac{3}{4}$ in. stroke.

The crankshaft is $\frac{5}{16}$ in. diameter with inside cranks of disc pattern, with eccentric sheave placed in between them—the whole turned out of the solid.

The connecting-rod is of mild-steel with adjustable bottomed brasses.

The flywheel is a plain mild-steel turned disc with *recess* to take flanged coupling on shaft end and secured to latter by three bolts and nuts. (Let me pause here and say that I found this an easy way to fit the flywheel, and easier still to rectify any tendency it might have to run out of truth; the fitted coupling bolts hold it just as securely as any key.)

The "Bremme" Valve Gear

The valve gear is of the "Bremme" type, said to be a modification of the "Marshall" gear. The eccentric strap is a banjo-shaped affair which works horizontally and at *right-angles* to the shaft. This banjo affair really constitutes a beam or lever and is suspended at a point (about two-thirds its length, as measured from the centre of the shaft) by a swinging pendulum, the centre of which constitutes a fulcrum, which collectively gives the required amount of travel to the free end of the lever, which in turn is transmitted to one of the valve spindles (through the medium of an eccentric rod) and thence by a lever to the *other* valve spindle.

The lever is fitted with little *sliding* blocks to take care of the arc or radius inseparable from direct-connected mechanism of this kind.

The piston-rod crossheads are of brass, milled out to take mild-steel square guide bars, and have little plates on sternways side of the bars, each secured by four $\frac{1}{16}$ -in. round-head screws. The upper portion of the bars is flanged and bolted to the cylinder bottom plate.

Reversing Control

Reversing is controlled by a steel lever working in a brass quadrant with suitable knurled thumb-screw to lock it in any desired position, and (as in the prototypes) the engine follows the direction of the lever, i.e., if the latter is pulled over to the left, the engine works from right to left and vice versa.

The engine columns are not columns at all, but rather *frames*. Three of these frames came with the castings, but I only used two, and I overcame the difficulty of drilling the *main bearing* bolt-holes by drilling from the bottom side instead of from the top side.

An Interesting Problem

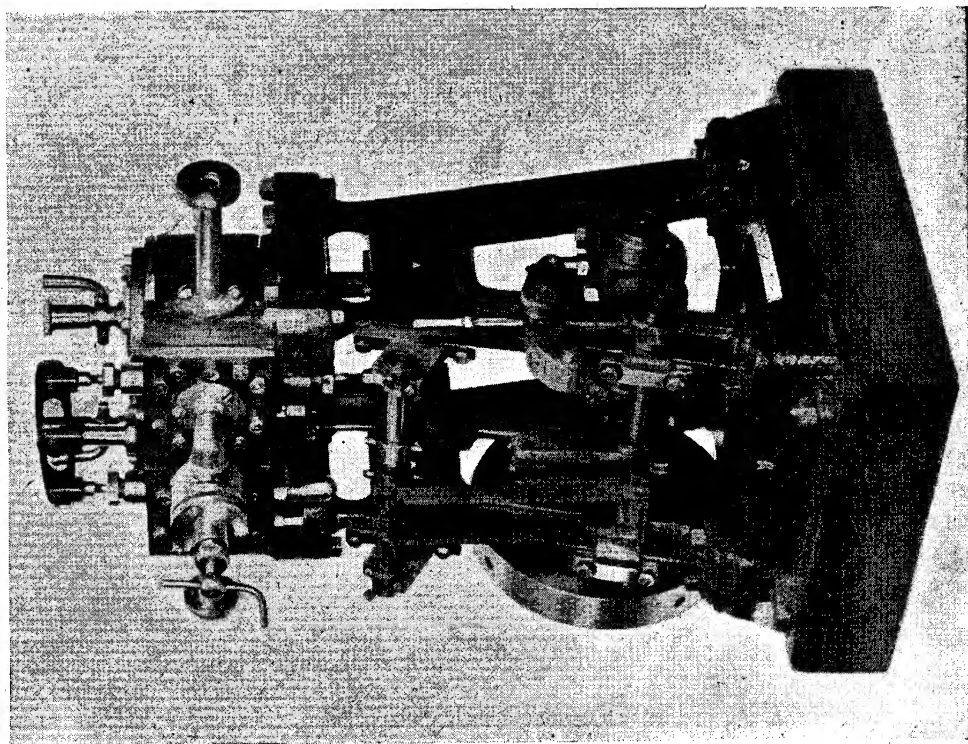
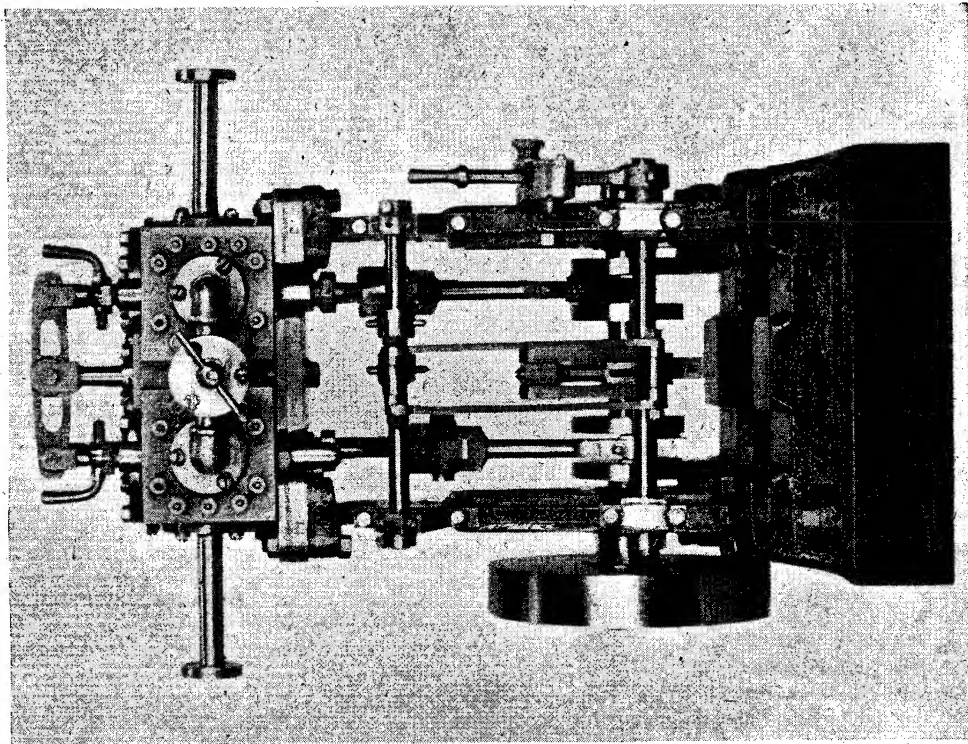
The most interesting part of the construction was in finding the correct positions of (1) the reversing shaft, (2) height of its reversing crank, (3) distance between centre of latter to the centre of eye in the eccentric-rod.

"Fowler's Engineers Handbook" (1932 edition) pages 347 and 348 deals with this type of radial gear and I am indebted to the author of the said most excellent little book for the diagrams and formulae which enabled me to plot out the various centres and so forth according to their proper ratios.

Keep the Hobby Alive

Few of us have much spare time to devote to model engineering these days, but it is something that has to be kept alive, for it teaches amongst other things the use of tools and stimulates creative ideas, both of which can be used to good purpose wherever our walk in life may take us.

That THE MODEL ENGINEER has performed a great service in this respect is putting it mildly.



Views of a successful model of a double-cylinder vertical engine.

*Small Capstan Lathe Tools

Notes on "tooling up" for repetition work, with special application to the
"M.E." small capstan attachment

By "NED"

IN order to use taps and dies efficiently, the mandrel must be run at a very much lower speed than that used for normal cutting operations; and in this respect, the user of a small "converted" lathe is at a great disadvantage, as the latter is not usually equipped with any quick or facile means of changing speed. Nearly all modern production lathes either have all-g geared headstocks, or are otherwise equipped in such a way that a shift of a lever is sufficient to change from cutting to screwing speed, or to reverse the mandrel for backing-out.

An Easy Problem

The problem of providing a power reverse on a small lathe is not a difficult one, as it can be done by means of a reversing switch, in cases where an individual motor is employed; if the lathe is driven from a line-shaft, the use of two belt drives to the countershaft, one open and the other crossed, and each having its fast and loose pulley, will provide a rather more cumbersome but still serviceable solution. But the only means normally available for reducing speed in such cases is by shifting the belt from one step of the cone pulley to the other, or by engaging the back gear. Neither of these methods is really expeditious, especially the latter—which is nearly always the only way of getting a sufficiently slow speed for anything but the very lightest screwing. In most lathes, the engagement of the back gear involves a double operation—namely: (a) the release of a bolt, clutch, or other means of positive coupling between the cone pulley and the mandrel, and (b) meshing of the back gears by means of an eccentric or sliding shaft. On re-changing back to high-speed drive, these processes must, of course, be reversed, and the total time occupied thereby may be more than that taken up in the actual cutting operations. Quite clearly, some more expeditious means of speed changing may be regarded as almost a necessity for serious production work.

For the cutting of threads which are neither very heavy nor very long, some workers manage tolerably well by turning the lathe mandrel by hand for the screwing operation. The usual procedure of hauling away at the belt, however, is not very satisfactory, and is liable to be rather tiring if much of it has to be done. In at least one

case within the writer's experience, the use of a crank handle, so designed as to be capable of being quickly applied to the tail end of the mandrel, and as quickly unshipped, has been found quite satisfactory. In practice, quite heavy threads can be cut by this means, and incidentally, it may be mentioned that this simple lathe attachment is often found useful, apart from its application to production work, as it can be used to simplify and facilitate the generation of heavy threads, or to provide an emergency slow-speed reversible drive for other purposes.

There can be no doubt, however, that the provision of a quick-change gear would be a great boon on any small lathe intended for production. Instances have been brought to light where lathe users have contrived to make use of motor-cycle or car gearboxes, or other variable speed mechanisms, in the lathe driving gear, in the attempt to achieve this end. But in spite of the ingenuity often displayed in these schemes, their success is not what it might be for this particular purpose, mainly because the gear-changing mechanisms in question, being designed for a very different type of duty, do not provide the most suitable gear ratios, or a sufficiently wide range of speeds.

A Simple Slow-speed Power Drive

It is, however, possible to obtain a very satisfactory slow speed on a simple lathe by slightly modifying the arrangement of the back gear and providing a small auxiliary motor. The way in which this is done is shown in Fig. 27, and it can be applied to most back-g geared lathes in which the gears are engaged either by eccentric or sliding shaft; the modification required is only a temporary one, allowing the back gear to be refitted in its normal form in a few minutes when required. If, however, it should happen that the back gears are not individually removable, but are made integrally with the shaft or quill, it is a little more difficult to apply this method. However, the provision of a spare shaft or quill, equipped with the pinion and belt pulley as shown, would effectively surmount this obstacle. Indeed, it would be quite practicable to apply the idea to a lathe not equipped with back gear at all, by mounting a large change-wheel on the tail of the mandrel, and a sleeve carrying a small pinion and a large belt pulley, running on a pin attached to the change-wheel quadrant. For rapid operation, it

* Continued from page 563, "M.E.," June 11, 1942.

would be desirable, however, to provide an eccentric tumbler, or other means of quick engagement.

The belt pulley, which should be as large as possible within the available space limits, is used to transmit the drive from a small electric motor mounted in any convenient position in line with same. Quite a small fractional h.p. motor (say about 1/20 h.p.) will provide sufficient power, provided that it can be geared down sufficiently; an ordinary "universal" motor which can be reversed by simply changing over the field or armature connections (not both) will be the simplest type to apply.

In use, the procedure is as follows: The lathe is first stopped, either by switching off the main motor or by shifting the belt over to the loose pulley; the back-gear pinion is brought into mesh, and the auxiliary motor switched on, so that it drives the back gear shaft by means of the belt, and from thence the drive is transmitted to the mandrel through the pinion and spur gear. When the screwing operation is completed, the auxiliary motor is reversed to back out; after that it is switched off, the gears disengaged, and the lathe driven normally until slow speed is again required.

If an extra auxiliary motor is not available, or if its use is objected to, it is possible to obtain the same result from lineshaft drive, by fitting up a small auxiliary countershaft—quite apart from the lathe countershaft—and equipping it with two-way belt shifting gear.

Limitations of Small Capstan Lathes

A question which arises frequently in connection with the use of small lathes for production work is that of their maximum capacity for producing screwed parts. It is, of course, readily appreciated that screwing imposes the maximum strains on both the mandrel and the capstan mechanism, and in regular production lathes it is customary for the makers to specify some definite figure for the maximum size of thread which can safely be cut in them with normal types of taps and dies. The torque load depends not only upon the toughness of the material and the efficiency of the tools, but also upon

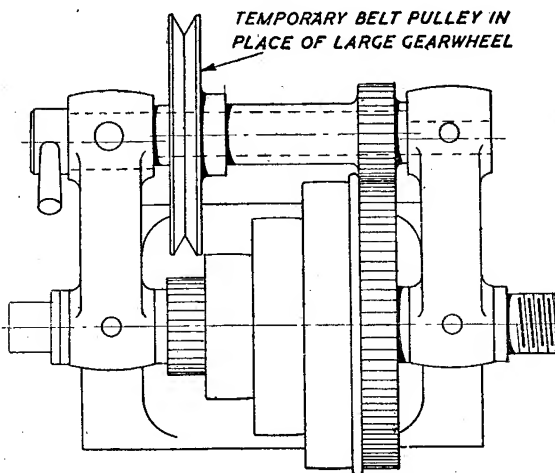


Fig. 27. Back gear of lathe, modified to provide a quick-change slow-speed gear from an auxiliary motor or countershaft.

using a cheap (but, nevertheless, fairly good quality) circular die, and lubricating with soluble oil. While this may not represent the maximum screwing capacity, it is fairly certain that higher torque loading would impose unfair strains on the capstan gear, and eventually lead to unduly rapid wear or other mechanical trouble.

To some readers, this arbitrary limit may seem a very low one, but if one compares it with that specified for regular capstan lathes of somewhat similar sizes, in respect of bed, slides and mandrel, it does not show up at all badly. Lathe makers are, quite rightly, very cautious in rating maximum capacities of their products for continuous production work, and the user of a "converted" lathe will be wise in adopting conservative estimates as to its capabilities.

More about Floating Tool Holders

With reference to my notes on these appliances, in the May 14th issue, a Glasgow reader has written to tell me of his experience with them, and also to raise some practical questions in the use of both fixed and floating boring cutters. He has observed that in actual practice the behaviour of both types of cutters does not invariably conform to what it should be from purely theoretical considerations, and asks for an explanation of the discrepancies.

The problems which he has propounded (in order to state them concisely, his actual words have been freely paraphrased) are as follows: It is assumed that a hole has been bored out by means of a single-point boring tool to within a few thousandths of finished size, and proves to be tapered (say, small at the back end) through faulty alignment of the tool slide. The question now arises:

the form and pitch of the thread being cut. Obviously, a coarse pitch thread requires more power to cut than a fine one, because both the depth of cut and the rate of traverse are greater.

So far as actual experience goes, the "M.E." capstan attachment, fitted to a 3-in. lathe of a type very common in model engineering workshops, has cut threads up to $\frac{3}{8}$ in. B.S.F. (20 t.p.i.) in free-cutting mild steel,

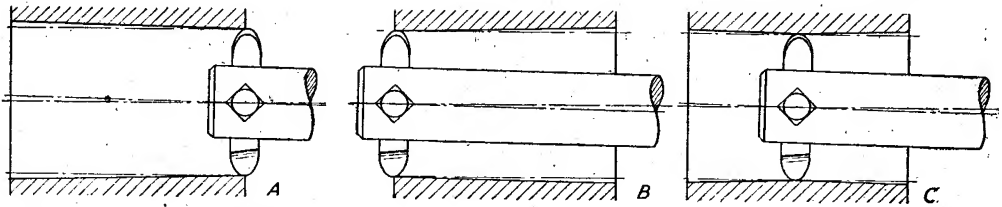


Fig. 28. Action of fixed double-edged boring cutter, when traversed on a line not truly parallel to work axis. Cutter centred, (A) at front of hole; (B) at rear end of hole; (C) midway through hole.

if this hole is finished (a) by a double-edged cutter, fixed rigidly in a solid tool bar, or (b) by a double-edged cutter free to float in its holder—will either or both produce a perfectly parallel hole?

To understand these questions properly, it must be appreciated that the terms "fixed" and "floating" can only be applied in a relative sense; in practice, no cutter can either be fixed absolutely rigidly, or perfectly free of any constraint.

Centring the Cutter

But assuming, for the purposes of argument, that we have, in the first case (a) a cutter which is definitely fixed in its relation to the cutter bar, and thus in relation to the tool slide by which the bar is traversed. (Although not expressly stated, it is tacitly assumed that the bar is attached to the same slide as that used for the boring tool used in the preliminary operation, and therefore subject to the same error of alignment). Now, the first question which must inevitably arise, is with regard to the centring of the cutter. If its line of traverse is not exactly parallel with that of the mandrel, it can only intersect it at one point of travel; and thus, if it should be exactly centred at one end of the bore, it will be out of centre at the other, and vice versa. (See Fig. 28.)

Therefore, it follows that in the event of the cutter being set exactly central with the bore at the front end, so that both edges cut equally, it will in every case cut large at the rear end, *irrespective of the direction in which the slide traverse is out of alignment*. If it is set central at the rear edge of the hole, it will cut large at the front; and if set central half-way through the bore, it will cut a double taper, large at each end, and small at the middle. (By the way, it may be mentioned that this principle has been used deliberately for producing a double taper by the straight traverse of a single tool, in automatic lathe practice.) The moral of the whole thing is, that it is quite impossible to produce a parallel hole by any form of fixed cutter unless the line of traverse is dead parallel with the work axis.

In the case of the second cutter (b) which is free to float, the exact centring of the cutter does not depend upon the slide alignment, unless there is some impediment to its free movement in the slot of the bar. As a matter of fact, there often is, in practice; either traces of dirt or swarf, or just mere rubbing friction, will impair the floating action sufficiently to produce slight errors, which are probably not constant in successive holes bored. If, however, free floating is not interfered with, the cutter is bound to produce a perfectly parallel hole, so long as both its cutting edges cut efficiently, and do not snatch, tear or dig in.

But although the hole produced may be parallel—that is, constant in diameter from end to end—and also constant in diameter at any position around the circumference, it may still be out of circular accuracy; as pointed out in my previous comments on floating cutters. While this has no special bearing on the questions raised by our Glasgow correspondent, it is a point which should be very carefully watched, in cases where such components as cylinders have to be bored. A two-point cutter can never be depended upon to produce circular accuracy, and an odd number of teeth, unevenly spaced, should be used for this purpose. This does not mean to say that true cylinders cannot under any circumstances be bored by means of two-point cutters, but simply that the latter, in themselves, have no power to generate true circular accuracy.

Causes of the Trouble

It should be mentioned that, in practice, many of the difficulties encountered in boring truly circular and parallel holes arise from failure of the cutter edges to cut efficiently and freely. Wrong rake and clearance angles, local wear, or chipping of the edges, and clogging with swarf are prolific causes of trouble. In modern production, close control of the grinding and setting of tools, and the use of rose reamers and similar special sizing tools, assist greatly in holding work to close limits.

(To be continued)

A Fixture for Slotting Screw-Heads

VERY often the engineer and model-maker finds it convenient to form, by hack-saw, the screw-driver slots in the heads of cheese-head or set-screws, as when making up special screws, etc.

The smart appearance and finish of such screw-heads can be irremediably marred if the driver slot is not located exactly central in the head portion, or if not cut straight.

The accompanying illustration shows the construction and method of using a very simple, inexpensive bench vice fixture, designed and employed by the writer for overcoming such difficulties.

The fixture consists of a mild-steel block A shaped as shown, so as to conform roughly to that of an L. This shape ensures a sufficient degree of overhang of the top portion of block beyond clamping faces of the vice jaws to prevent unbalancing of the fixture when resting thereon prior to clamping proper.

This top portion is provided with a recess as at B, which should be made appreciably larger in width than the height of the largest screw-head to be sawn.

The lower portion of the block is provided with a vee-slot C, located exactly vertical on the left-hand face. This slot is for receiving and positioning the shank portion of the screw correctly.

The long top portion is then machined with a narrow slot E slightly wider than the thickness of the hacksaw blade, for which it serves as a guide. This slot extends the

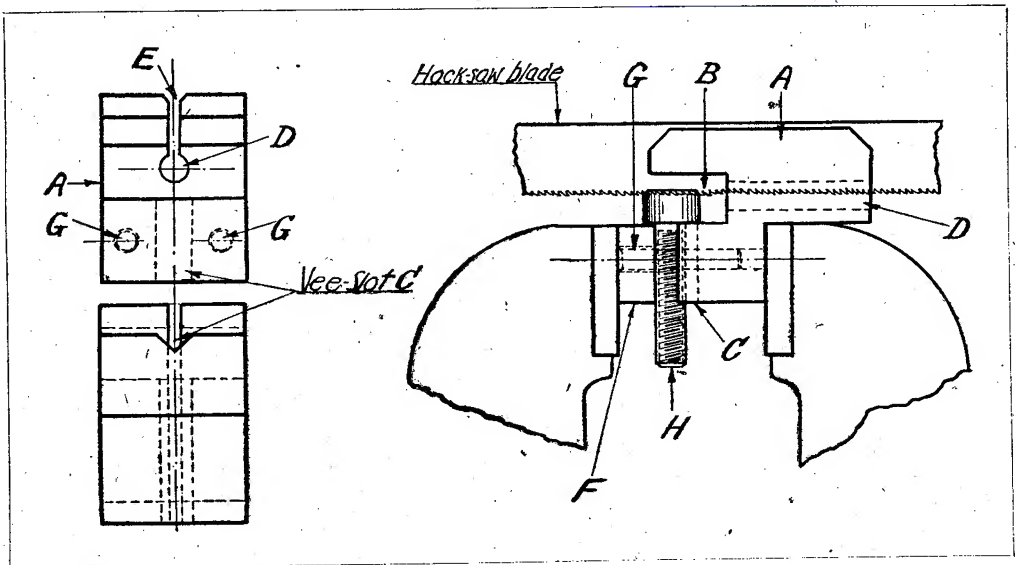
full length of the long top part of block, and is deep enough to pass clean into the horizontal hole D, drilled through top portion of block A, as indicated. The purpose of this hole is to allow due clearance for teeth of saw blade when actual cutting occurs. If no such clearance was provided, the sharp edges of the teeth would speedily become worn dull by reason of the rubbing action with slides of slot E. The slot E should be located on exactly the same vertical centre line as that of vee slot C.

Clamping of a screw is secured by means of the rectangular clamp-plate F, which may be of mild-steel, and should be provided with two dowel pins G, these being tightly screwed to the plate. The extending portions of these pins should be a free sliding fit within matching holes drilled in the adjacent portion of block A at each side of vee slot C, as shown. H is the cheese-head screw to be cut with a driver slot.

The block A should, preferably, be case-hardened, particularly surrounding the saw blade guide slot E.

To load the fixture, the clamp-plate F is first pulled apart from the block A, and then a screw or stud is inserted; and in the case of a screw, its head portion falls within the recess B. The clamp-plate is then replaced and the whole assembly then simply placed within the jaws of a bench vice and secured in the ordinary manner, the screw thereby being firmly gripped between clamp-plate

(Continued on next page)



Parting-off in the Lathe

THIS subject has been referred to occasionally in back issues, but it is such a frequent operation, though not always a success, that it will bear another mention.

Of course, the tool point must be kept in proper condition and for ferrous metals a slight lip is sometimes an advantage; the more obtuse the cutting edge, however, the longer will it wear. Tool angles, etc., have all been dealt with before, so I will not make any suggestions under that heading, but I would emphasise the provision and maintenance of a proper side clearance behind the cutting edge. This clearance should be sufficient only to permit the sides of the tool to clear the work, thus preventing chips from becoming jammed between side of tool and work.

Where the work is supported at each end a frequent cause of jamming is bending of the work by frontal pressure of the tool at the point of cutting off. I am of opinion that cutting off should not be attempted on work running between centres—unless it is possible to use a steady to resist the tool thrust and preserve the straightness of the work. Excessive clearance behind the cutting edge will merely postpone the jamming which occurs when the metal remaining in the groove is insufficient to resist the pressure of cutting and the work is pushed away to the point where the sides of the groove close in on to the sides of the tool. If possible, therefore, cut off by holding work in the chuck and leave the other end unsupported.

Another necessity is a slow work-speed; it is better to err by running the lathe too slowly rather than too fast. If there is much backlash in the cross slide screw and nut the jib piece must be adjusted to prevent easy forward movement of the slide. A slack or easily moved slide will be drawn forward if the tool digs in and conversely a dig-in is rendered all the more likely by a slack

slide, which allows the tool to be drawn farther into the work by the cut itself.

I do much of my cutting-off with the tool upside down, working from the rear of slide. This is necessitated particularly when the usual position on the slide is occupied by other tools. The method is sometimes urged as a cure for digging-in, and I can confirm that it is very successful. The explanation seems to be that, generally, turning, etc., are done with the cross slide in a position of about one-half its full travel "home," with the result that the parts of screw and guides nearest the operator are barely worn. With the tool used upside down, approach to the work must be from the rear, which in the majority of the smaller lathes will require the cross slide to be advanced across the saddle almost as far as it will go, and this consequently brings into use parts of the screw and slide previously subjected to but little wear. The fit of these parts being on the tight side, there is much less tendency for the slide to be drawn along by the tool digging-in or to permit the tool to dig in through lack of proper restraint.

The tool must be clamped at centre height; if below, it can readily be seen how the work will tend to draw the tool towards it. Yet a substantial cut is permissible if the slide is moderately tight on its guides because the power required to remove, say, a double thickness of metal is not proportionately increased.

Finally, a steady feed is essential to success. A jerky feed obviously imposes sudden strain on tool point and work. I find my auto cross-feed (home made) invaluable if I have much cutting-off to do, as jerkiness in feeding the tool is thereby avoided. If a dig-in occurs in which tool and work become locked together, the tool point can be saved if the clamping screws are slackened before the slide is withdrawn.—L. A. WATSON.

A Fixture for Slotting Screw-Heads

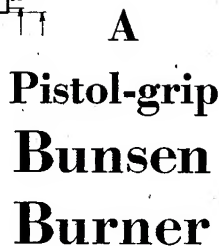
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and block. The hack-saw blade is then inserted into guide slot E at top of block and the slot cut to required depth. As the vertical vee slot C and guide slot E are in the same centre line, it is practically impossible to cut a slot in a screw-head off the centre.

If desired, the clamp-plate F may be made of a softer material than mild-steel, such as

brass or copper, in order to obviate bruising the threaded shanks of screws, etc. When having to handle highly-polished pins or precision screws, it may also be desirable to face both sides of the vee slot C with a similar non-marring material, such as fibre, hard rubber, soft copper, etc., so as still further to afford protection to such highly polished surfaces.

It will be appreciated that this fixture will have a number of similar applications; and indeed, the writer has found it invaluable for slotting all kinds of studs, pins, rollers, discs, as well as screws.—W. M. HALLIDAY.



(Continued on next page)

BRAZING MODEL PARTS

By A. J. T. EYLES

IN spite of the growing use of welding, the process of brazing remains one of the most familiar in model making, and the art of brazing will continue to occupy an important place in model construction. Brazing is the art of uniting metals together by fusing a hard-solder, in connection with a suitable flux, with the aid of a gas blow-pipe, a blowlamp, a blast fire, or otherwise.

The strength and tenacity of the brazed joint depends much on the composition of the brazing spelter and its melting point. As a general rule in uniting model parts, the melting point of the brazing alloy should be as high as is consistent with the work in hand, yet always below that of the metals to be brazed.

The higher the melting point of the brazing spelter, the stronger and more tenacious will be the brazed joint. Brazed joints in connection with steel, iron and gunmetal (all with melting points above that of the hardest brazing spelter) are necessarily required to be very strong and tenacious.

When the metal is thoroughly cleansed, metallic contact should be ensured (as far as may be practicable), and provision should be made to prevent warping under the influence of heat, before attempting the actual brazing operation.

The best results are obtained when the metal in the vicinity of the joint is raised to the same temperature as that required to melt the brazing spelter. Therefore, broken pieces of coke or firebrick should be piled on the metal to conserve the heat, excepting, of course, that part where the actual brazing is to be done. Firebrick had better be used when brazing iron or steel. Coke is practically a form of carbon, and carbon is capable of combining with iron and steel. If an appreciable amount of carbon becomes associated with iron or steel model parts, they are liable to become brittle as a consequence. There is no possibility of

any such danger when firebrick is used.

The best and most reliable flux for brazing is borax, as when it is sufficiently heated, it fuses and flows readily as a film over the surfaces to be united, thus protecting them, as well as the brazing spelter, from oxydising influences. Further, it combines with such metallic oxides as may be present, and thus enables the brazing spelter to flow uninterruptedly where required.

The borax should be roasted or strongly heated before use to evaporate the water of crystallisation. Unless this water be first evaporated it will cause the borax to swell and possibly fall off the model part during the brazing process.

The borax and brazing spelter should be mixed together in a little water and then applied in its wet state to the metal model. The heat should then be directed on the surrounding metal first of all, and finally on the brazing spelter until the latter fuses and flows readily to make a sound joint. A pinch of dry borax powder thrown on the brazing spelter just before it melts will facilitate the process.

Brazing spelters or solders are usually purchased in a granulated form so as to facilitate melting. The usual sizes made are 00, 0, 1, 2, 3, 4 to 7, the 00 size being exceedingly fine.

BRAZING SPELTERS

Metal to be Brazed	Aprox. per cent. Copper	Composition per cent. Zinc	Melting Temperatures	
			Deg. C.	Deg. F.
Iron and steel ..	66	34	918	1,684
Copper ..	60	40	890	1,634
Brass, hard ..	50	50	880	1,616
Brass, soft ..	33	67	803	1,477
Stainless steel ..	33	67	803	1,477

By referring to the above list of brazing spelters, the selection of one to suit any particular work can be readily made.

A Bunsen Burner

(Continued from previous page)

many silver-soldering jobs of varying sizes, and will be used—circumstances permitting—on the brazing of a boiler for a gauge “1” “Molly Stainier,” which is now “on the stocks.”

The burner should then be tested and the air hole filed until the smallest jet of unburnt gas is attained (for those who haven't

used a bunsen before, the unburnt gas is the blue cone in the roaring flame).

When in action it looks like a pocket flame-thrower and develops quite enough heat for brazing small articles, and bigger ones if done slowly. Its bigger flame gives it an advantage over the laboratory bunsen in that it keeps the surrounding area hot. For those without a blow-lamp it is a useful substitute, and for those with one it saves a lot of pumping for small jobs.

"MAURETANIA"

THE steam and speed control is a most interesting piece of mechanism, and the scheme was kindly given to me by an expert in this system of control, which is illustrated below. The control is actuated by both compressed air and electricity. Cylinder "A" is actuated by compressed air. The piston is a brass one about $\frac{1}{2}$ in. in length, with oil grooves, and it had to be very carefully ground in. The piston-rod is attached by a forked joint to a sort of connecting-rod which, again, is connected by means of a movable bracket to a rod which actuates the main steam tap. The tap is a simple plug-cock which has been very carefully ground in, in order to work easily, and is reasonably steam tight. The piston-rod has a stroke of $1\frac{1}{2}$ in. Now comes the really interesting part of the whole control; the external part of the piston-rod, which is $1\frac{1}{2}$ in., was marked in the centre, and a hole was made and a pin driven through. To this pin a forked joint "B" is attached. This, in turn, is connected to another kind of double-forked joint by a short piece of rod. Through this forked joint passes the rod of

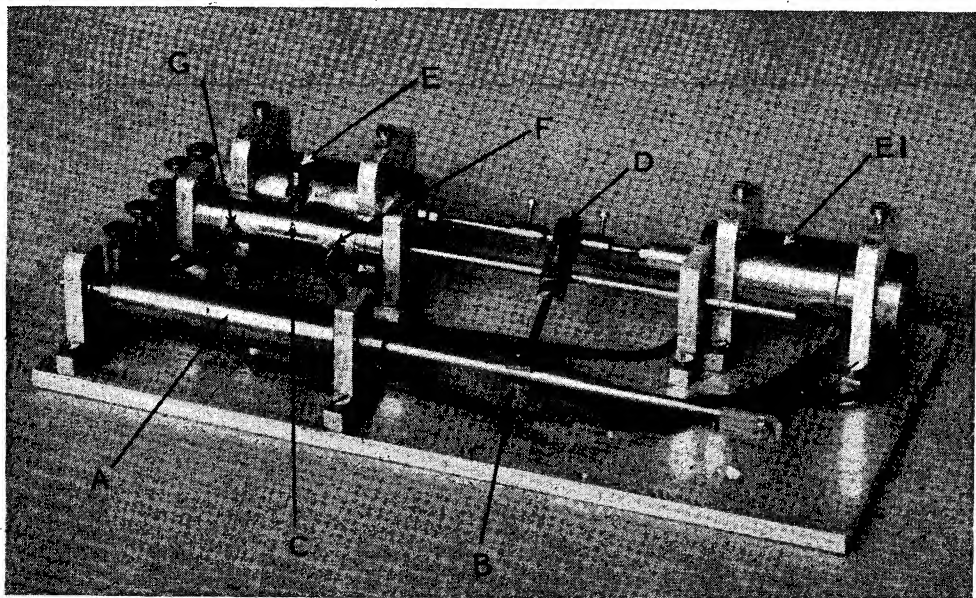
*** Mr. Victor B. Harrison continues with details of the steam and speed control, and the steering control during the reconditioning of his model**

the piston-valve "C". This is an internal-admission type of valve, and leads the compressed air to either end of the cylinder "A." The valve

cylinder itself is open-ended for the exhausts. As compressed air is used in the apparatus, it is not necessary for the exhaust to be led anywhere particularly. At the centre position of the stroke of the piston-valve rod another pin is fixed which passes right through the rod. This forked joint has to be slotted, both laterally and vertically, to allow, first, the rod to change its position in the fork and, secondly, to allow the pin in the valve-rod to do the same. This joint is connected to another forked joint "D," through which passes the rod connecting the two armatures of the solenoids "E" and "E¹." Its position on the rod is secured by two collars which are capable of being adjusted.

The distance between the main piston-rod, the valve-rod and the rod connecting the two armatures had to be graphically calculated. The reason for this explains itself in the description of how the whole apparatus works. When the apparatus is in the "stop" position, the piston-rod of the cylinder "A" is at the bottom of its stroke, viz.: to the

**Continued from page 582, "M.E.," June 18, 1942.*



The throttle control.

right of the illustration and the armature of the solenoid "E" is in the centre of the coil. The piston-valve in the cylinder "C" is in mid position with both ports closed. It can be seen in the illustration that the solenoid "E¹" is in two portions, which are wired together in series. This is done so that the armature of the solenoid "E¹" can take up two positions, viz.: two-thirds of the way in and completely in.

It was found that, in order to get the main engines running at a slow speed, the piston-rod of the cylinder "A" had to move exactly one inch, and for "full steam ahead" it required the piston to move only an extra half-inch. This greatly simplified the whole design of this part of the mechanism, because, if it had turned out that the main movement had been in odd fractions of an inch, the positions and movements of the other rods would not have been so simple to lay out.

"Slow Speed Ahead"

When the suitable wireless impulse for "slow speed ahead" is transmitted, it will bring into action the correct switch for this purpose. In this case, it will energise the first two-thirds of the solenoid "E¹," and it has the effect of moving the forked joint "D" to the right. As the fulcrum of the lever connecting the three rods is at "B," the valve-rod of the piston-valve "C" will be moved so that the port "F" will open. This allows the compressed air to enter the cylinder "A," causing the piston-rod to move to the left. When this rod moves, "D" becomes the fulcrum of the cross connection and, therefore, the valve-rod also moves to the left. This movement will continue until the port "F" is closed. The mechanism is so designed that the main piston-rod moves exactly one inch to open the main steam valve to the required position for slow speed. Further, when the appropriate wireless impulse is transmitted and the necessary contact made on the receiving panel, the last third of the solenoid "E¹" is energised; thus, the whole solenoid is acting on the armature, causing the armature to enter the coil completely. The result is that the port "F" is again opened and the original movement completed, and so the steam tap is fully opened. If slow speed is again required, the original signal is sent and the armature will take up its slow speed position. In this case, by the valve-rod moving in the opposite direction, the port "G" will be opened and closed when the piston-rod of the cylinder "A" is in the slow-speed position.

When it is required to stop the main engines, the necessary wireless signal is sent and the solenoid "E" will be energised. This makes the fork "D" and the main

piston-rod to go back to their original positions, thus turning off the main steam valve. On test, by manipulating the contacts by hand, the whole mechanism worked perfectly.

The Steering Control

The arrangement for steering the vessel was made possible by Messrs. Bassett-Lowke putting on the market a very fine small permanent magnet electric motor. It is the best motor of this kind I have ever come across. I am not comparing it with motors which are used in "O" gauge electric locomotives, but rather with those permanent-magnet motors sold as separate units. This motor proved itself to be absolutely ideal for the rudder control; a cycle-lamp battery was ample for operating it, and it gave plenty of power, but its speed was rather high.

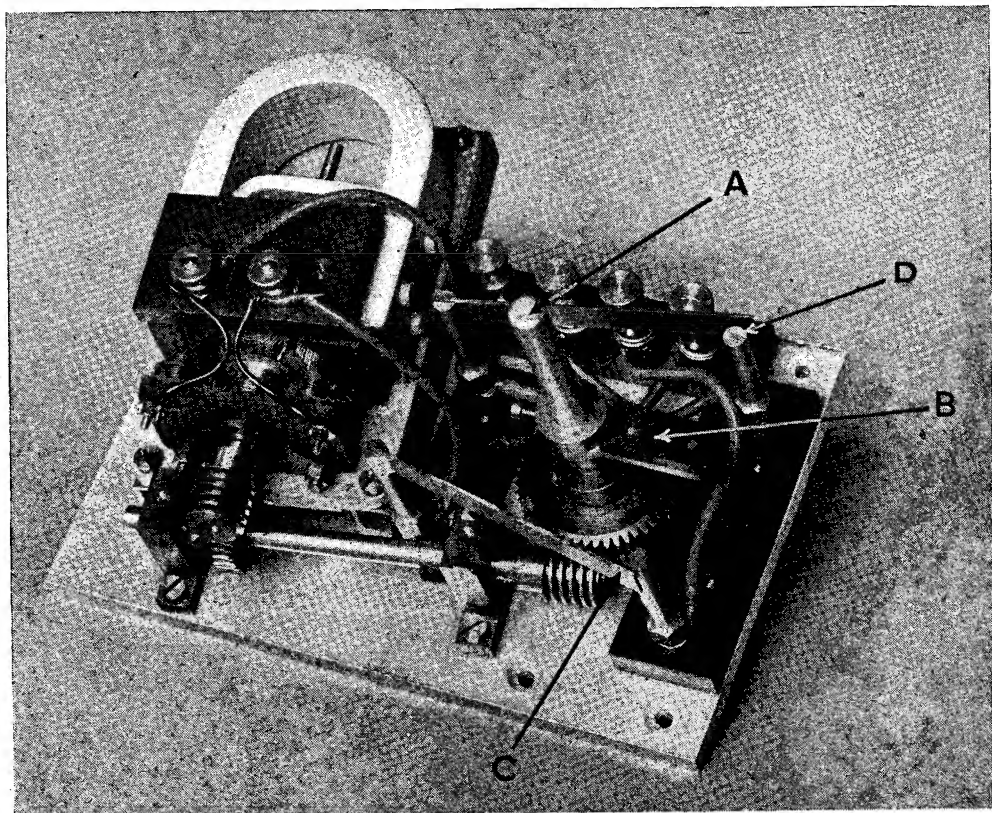
With our scheme of wireless control it was impossible to reduce the period between the switching on of the current and cutting it off to less than $\frac{1}{2}$ sec. I judged the speed of the motor to be about 3,000 revs. a minute. In about half a second the average revs might be 1,500. I wanted to be able to give very slight movements to the rudder, so that accurate steering by wireless could be made possible.

I found that the only way to accomplish this would be to gear the motor 1,250 to 1. This figure was rather settled by what gears I was able to purchase. The first step with the worm-gears is 25 to 1 and the second step is 50 to 1. These gears can be clearly seen in the photograph, which illustrates the whole mechanism. On test, it was found that in half a second the rudder moved through an arc of $3\frac{1}{2}$ deg.

Another Problem

The next problem to be solved was how to prevent the rudder going too far in either direction. This safeguard is arranged as follows: "A" is the rudder post and "B" is an insulated arm attached to it; this arm corresponds to the position of the rudder and moves with it. If a signal is sent to set the rudder in motion to port, the current will be switched on by the control panel to the terminals "E" and "E¹," and the rudder will continue to turn in that direction till either the signal is cancelled or the arm "B" strikes the spring contact "C." The moment the contact is broken the motor stops working and, therefore, the rudder also stops moving.

The only signal now that the motor will respond to is one to make the rudder go to starboard. For this the control panel will switch the current to the terminals "F" and "F¹," and the rudder in this case will continue to go to starboard until either the



The reversing control.

signal is cancelled or the insulated arm comes in contact with the spring contact " D " and so breaks the circuit. As before, the motor will now only respond to a signal to make it go in the opposite direction.

These safeguards had to be introduced because the rudder's exact position would not be visible from the shore; and also, if the arc it describes were not limited, it would be possible for the rudder to turn and foul the propellers and so create a major disaster with far-reaching results. The diagram of the wiring explains how all this is accomplished.

All this new apparatus, installed in the ship altered her trim and necessitated the redistribution of the weight of the keel. This has had to be removed and it was then found that it needed re-casting in order to redistribute the weight. It also required reducing about 10 lb. in weight so that the ship would float at its original water line. This old keel, by the way, weighs 44 lb.

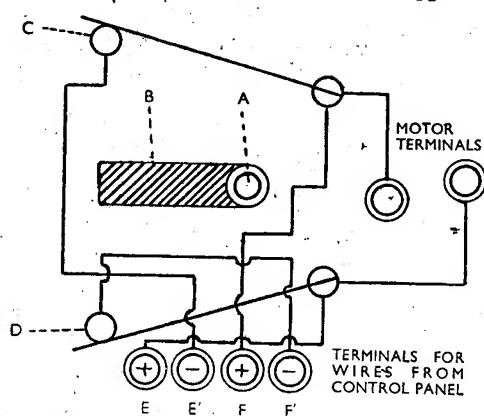
The new keel will be made of brass and will be removable so that it will be easier to transport the ship and take her out of her show-case. In the show-case the wooden pattern of the keel will be bolted on to the

hull in place of the brass one so that everything will appear ship-shape. Unfortunately, I am getting less and less spare time now to devote to my hobbies; nevertheless, I am hoping some time this summer to have a test on my pond of all the controlling mechanism. The only way this can be done is by connecting the wireless reception panel by flex to the transmitter. In this way, I shall be using a direct impulse in place of a wireless impulse. It may be possible to use a single fine wire by earthing both the transmitter and the ship. One of my friends says that if this works it might be possible to use a fishing-rod for supporting the wire and give the ship a trial run on the River Stort, which is really only a canal, and I see no reason why this should not be possible. Naturally, one could not let the ship go very far away, but one would get quite a lot of fun making her perform all sorts of manoeuvres.

I only hope now that when this ghastly war is over and the necessary permission can be obtained to construct the transmitter, no unforeseen snag turns up. I am assured by my friends who are experts on these matters, that I need have no worries on that score,

Adjustments and adaptations may have to be made, but it will not only work well, but over quite long distances.

There is one thing my son and I made a mental note of, and that is that whoever is in control of the transmitter must not be distracted in any way when the vessel is under way. In fact, it was suggested



Wiring diagram of the steering control.

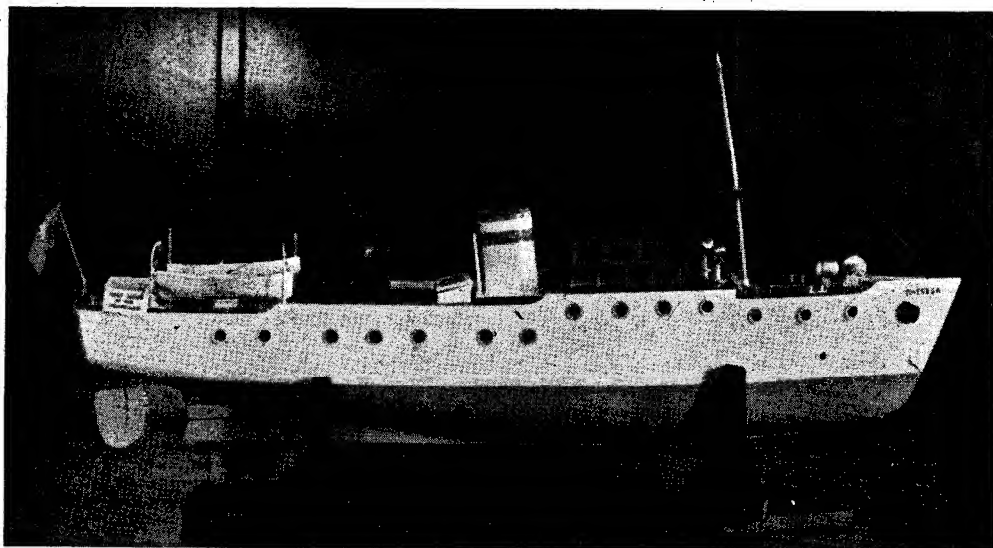
that when the boat is on some public water a notice must be stuck up next to the controller: "Do not speak to the man at the control!" This will be especially necessary when the ship is being

brought alongside at any time. The control is quite simple, but when signals for stopping and reversing the engines are transmitted and also the helm has to be controlled, it will require all one's wits not to make a mistake. Full speed ahead at the wrong moment might cause a major disaster with a model weighing about 80 to 90 lb.

Here I must leave for the present the story of my model *Mauretania's* reconditioning. When peace reigns once again, my son will, no doubt, write a full description of both the wireless receiver and transmitter. This will, I hope, prove of interest to readers and will complete the story.

* * *

Having been granted an interview with a member of the Radio Branch of the G.P.O., I put to him the question of constructing transmitting apparatus and transmitting itself, as applied to models during the period of the war. I was shown an Emergency Power Order, in which it definitely states that it is prohibited to acquire, possess, or to use wireless transmitters which are designed to be used or are capable of being used for the purpose of the remote control of machinery. This, undoubtedly, would take in the control by wireless of model boats of any description. Statutory Rules and Orders, 1939, which contain these prohibitions are Nos. 1687, 8 and 9, copies of which can be obtained, price 1d., from H.M. Stationery Office.



The model motor boat "Theresa," a first effort at boat building by Mr. D. W. Vick. It is powered by a Bassett-Lowke "Eclipse" engine and twin-drum boiler.

"Molly's" Injector

By "L.B.S.C."

THE injectors fitted to the big "Molly's" are Gresham and Craven's No. 8 type and are located behind the cab steps, between them and the trailing wheel. This particular type of injector is similar to the kind I sometimes make for feeding hot water, and I thought about describing it for this particular engine; but when I made a drawing of it and compared it with the drawing of the injector specified for "Miss Ten-to-Eight," the latter seemed ever so much simpler, especially for those who are building "Molly" as a first attempt, that I decided to revert to it.

Maybe at a later date I will describe the hot-water injector, and then anybody who feels plucky enough to tackle it, can swap over. Meanwhile, the one described below is easy to make and instal, perfectly reliable, and uses very little steam. A similar one, with the cones drilled to the smallest of the given combinations, is on old "Ayesha" at the present moment; and a few evenings ago, time of writing, when I took her out to test a small repair of which she was in urgent need after twenty years' faithful service, she would blow off with the injector working, provided the fire was good and bright.

Body

This can be made from the solid, or built up as described for "Miss Ten-to-Eight," whichever you please. The overall length is 13/16 in., as specified for the engine mentioned above. To make the first-mentioned, a piece of brass rod $\frac{5}{32}$ in. by $\frac{3}{8}$ in. section will be needed, the kind used for axleboxes will do very well; face off both ends in the four-jaw chuck to a little over finished length. Scribe a line down the middle of one end; and at 3/16 in. from the end of the line make a fairly heavy centre-pop. Chuck the piece of brass in the four-jaw with this centre-pop running truly. Four-jaw chucks sometime have the same effect on raw recruits, when trying to chuck work truly, as "Stepney" had on Curly when he first made her acquaintance; well, just run the tailstock centre up to the work, and the

centring can be done in a brace of shakes, as all you have to do is to adjust the jaws until the point of the back centre will enter the centre-pop.

Open out the pop mark with a centre-drill (I use size E "Slocomb" or "J. and S." for jobs like these), put a No. 24 drill clean through, and follow up with a 5/32-in. parallel reamer, using tailstock chuck for both. Turn down a full $\frac{1}{4}$ -in. length to $\frac{1}{4}$ -in. diameter, screw $\frac{1}{4}$ in. by 40 with die in tailstock holder, and skim off any burr. Chuck an odd bit of brass rod in three-jaw, $\frac{3}{8}$ in. diameter or over. Face off, centre, drill 7/32 in., countersink slightly with $\frac{1}{4}$ -in. drill, tap $\frac{1}{4}$ in. by 40, and screw the piece of brass into it. The outer end can then be turned down for a full $\frac{1}{4}$ in. and screwed in similar fashion. When both ends are screwed, the overall length should be just 13/16 in.

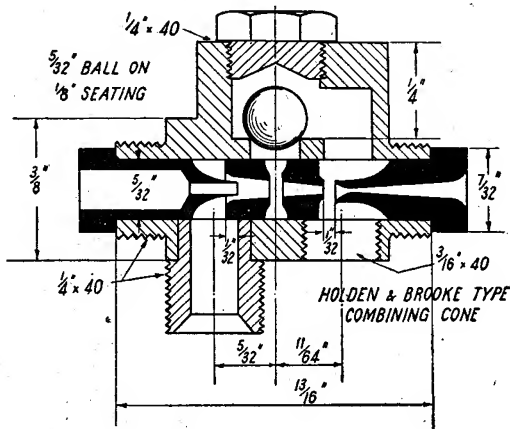
In the top of the body—that is, the side away from the screwed bosses—make a centre-pop dead in the middle, and chuck in four-jaw with this running truly. Open it

with a centre-drill, and follow up with a No. 32 until you pierce the bore, then further open out with a 7/32-in. drill, and bottom with a 7/32-in. D-bit to $\frac{1}{4}$ in. full depth. Slightly countersink the end, and tap $\frac{1}{4}$ in. by 40 about halfway down. Run a $\frac{1}{8}$ -in. reamer through the remains of the 32 hole.

Scribe a line along the middle of the bottom edge, and find the centre of the line; at 5/32 in. from it on one side, and 11/64 in. the

other, make two centre pops. Drill the first 3/16 in. and the second 5/32 in., tapping the latter 3/16 in. by 40. Both holes should break full diameter into the central bore. Chuck a piece of $\frac{1}{4}$ -in. round brass rod in three-jaw; centre deeply, and drill down about $\frac{3}{8}$ in. or so with a No. 32 or $\frac{1}{8}$ -in. drill. Screw $\frac{1}{4}$ in. of the outside $\frac{1}{4}$ in. by 40, and part off 5/16 in. from the end. Reverse in chuck and turn down about 3/32 in. of the plain end, to a tight squeeze fit in the 3/16-in. hole in the injector body; squeeze it home.

Now be very careful about the next bit, for in several of the "injector failures" sent



Section of injector (shown double size).

for my inspection, the outlet hole from the airball chamber has been drilled too close to the valve seat, so that only a knife edge was left, and it was impossible for the ball to seat airtight, hence the said failure. Grip the body upside down in the bench vice (don't forget the soft metal clams, to avoid marking it), put your centre punch down the tapped hole, and hold it so that it touches the side farthest away from the nipple just inserted. Make a centre-pop in the bore, and follow it up with a $\frac{1}{8}$ -in. drill to a depth of about $\frac{1}{2}$ in. A communicating hole, same size, has to be made from this to the ball chamber; and you can either poke the drill down from the top and drill through the side of the chamber on the slant, taking care to miss the seating, or drill through from the outside, and plug the end. Either a screwed plug or a bit of sheet metal silver-soldered over the hole, will do the trick, and the latter can be fixed at the same time as the nipple at the bottom is silver-soldered in. That is the next operation, after which the body can be cleaned up, the $\frac{5}{32}$ -in. reamer put through the bore again to clean out any burrs, and the "solid" side of the ball chamber filed away as sketch, for appearance sake. Round off the corners.

Cone Reamers

Three reamers are needed, all made from $\frac{5}{32}$ -in. round silver-steel. Chuck a piece about $2\frac{1}{2}$ in. long in three-jaw, and turn a straight cone point on it $\frac{13}{16}$ in. long. Repeat operation on another piece, only this time make the point $1\frac{1}{16}$ in. long. Turn a little curved point $\frac{5}{32}$ in. long, as shown in the illustration, on the end of a third piece. File away exactly half the diameter for the full length of the tapers, as shown; then make them red-hot and plunge into water. Touch the flat part of each on a fast-running emerywheel, or rub it with a piece of fine emerycloth on a flat stick. Put the reamer on a piece of sheet iron, and hold the lot over a gas or blowlamp flame; don't let the naked flame lick the reamer, or it will be spoilt. When the brightened part turns to a deep golden colour, tip the reamer in the cold water. Rub the flat on an oilstone, and the reamer is then ready for use.

Combining Cone

The centre cone, called the combining cone, should be made first, as it has to be pressed into the injector body, and is a permanent fixture. I have shown, for the sake of variation, three kinds of cones; two of these—the completely divided Holden and Brooke, and the double-slotted Sellers—are as used in full-size practice. The third, the "Vic" type, is a simplified version as used in the Eaton "Vic" injector placed on the

market 40 odd years ago, and still copied; the "Vic" injector, in turn, being a copy of one of the earlier full-size Holden and Brooke injectors with a single ball valve instead of two. This injector is on the same principle, and I always give "credit where due" by calling it the "Vic" type, although—as with the Carson oil burner—I have been able to improve it.

A Wheeze!

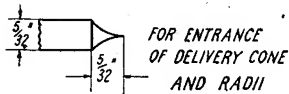
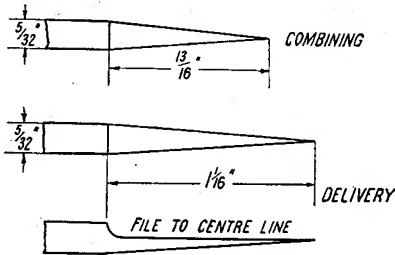
Chuck a piece of round brass rod $\frac{3}{16}$ in. diameter in the three-jaw, and turn down about $\frac{3}{8}$ in. of it to a tight squeeze fit in the bore of the injector. For novice's benefit, here is a wheeze. Drill and ream a $\frac{5}{32}$ -in. hole in an odd scrap of brass rod, same as you did in the injector body; a piece $\frac{1}{2}$ in. long will do fine. Now open out the end ever so slightly with an ordinary taper broach. If you turn the brass rod for the cone, until it enters the broached hole about $\frac{1}{64}$ in., it will be a jolly fine squeeze fit in the injector body. Face the end, centre, and drill it to one of the following sizes, viz.: 72, 70 or 66, according to what drills you happen to possess, or the degree of skill available for drilling small holes without breaking the drill. The depth of the hole should be about $\frac{5}{16}$ in.

Causes of Failure

Again for novice's benefit, the chief causes of an excessive decrease rate in the small drill tribe are, choking of the flutes and consequent seizure of the drill; not sufficient speed, and too heavy a feed. The first can be avoided by frequent withdrawals. When I am drilling a weeny hole, I keep on working the tailstock barrel back and forth as though it were a piston-rod, and have no difficulty in drilling a No. 80 hole to full depth of the flutes and even beyond. As to speed, you can't go too fast; give her the lot. Feed is a matter of judgment; just a slight pressure is all that is needed. These very small drills have to be held in a pin chuck, or else mounted in a stub of $\frac{1}{8}$ -in. brass rod, as they are too small to grip in the ordinary tailstock drill chuck; and if the tailstock chuck is closed down on the shank of the pin chuck, or the rod, as the case may be, just sufficiently to let it slide, the drill can be fed forward by gripping the chuck or rod between finger and thumb, and sliding it in the jaws of the larger chuck. You aren't likely to put on too heavy a feed by that means, and constant withdrawal is very easy.

To return to our cone, face off the end to remove any "belling" caused by the drill blunting its cut, then turn the end to a very blunt nose, as shown. Part off at $\frac{1}{4}$ in. from the end. Now decide which type of combining cone you are going to fit. The

Holden and Brooke gives the quickest pick-up and the best automatic restart if the injector "knocks off" for any cause; the "Vic" is simplest to make, whilst the Sellers strikes the happy medium. If you decide on the last-named, it would be convenient to turn the 3/32-in. groove a full 1/32 in. deep, with the parting tool before parting off the cone. Reverse the cone in chuck, whatever type, put the reamer with the



Cone reamers.

13/16-in. taper in the tailstock chuck, and carefully enter it into the cone until the extreme point just pokes through the other end. Now put the stubby reamer in the chuck; face off the end of the cone with a knife tool, just a mere truing-up skim, and take off the sharp arris from the mouth of the hole with the stubby reamer.

To form the Holden and Brooke cone, put the cone in the chuck with a shade more than half of the nozzle end projecting and saw it in two with a very fine hacksaw blade as used by jewelers. You won't get a parting tool thin enough, unless you happen to be an "expert at the game." Keep the saw against the chuck jaws. Then carefully face the saw mark off each half, and take off the sharp edge of the larger end of the hole in the nozzle section with the stubby reamer.

To form the Sellers' cone, cut two hacksaw or fine-file slots in the centre of the recessed portion, so that each breaks into the tapered hole through the middle. The "Vic" cone merely has a slot 3/64 in. wide, filed halfway through the middle of it. Put the taper reamer through again, to remove any burr.

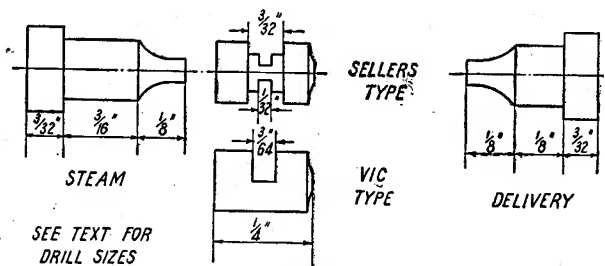
I don't suppose many amateur workers have a small bush or mandrel press—mine was a present from the late "Bro. Wholesale" of blessed memory—so you will have to fall back on the vice. Turn a bit of brass rod to

an easy sliding fit in the injector bore, and face the end off truly. Put a couple of pieces of angle brass (quite small bits will do) over the vice jaws at the middle, to act as clamps and prevent damage to the injector body. Hold the nozzle end of the cone against the end of the injector body which carries the feed union nipple, see that it is fair with the bore, and squeeze the cone in flush with the boss by aid of the vice jaws. Then open them a little, put the brass "plunger" rod against the end of the cone, and squeeze it in until, if a Sellers' or Vic, the slot can be seen exactly under the centre of the ball seating.

If a Holden and Brooke, only the first half will be pressed in, and it should go 1/64 in. past centre. The second half should be pressed in the same way, stopping 1/64 in. short of centre, so as to leave a gap of 1/32 in. between. Put the reamer in the cone and twist it with your fingers. If it turns with slight resistance, and doesn't shake, the adjustment is O.K.

Steam Cone

This is different from the usual type, inasmuch as the working part of the cone is only 1/8 in. long. The Gresham and Craven injectors on our old Brighton engines were very great on pick-up and restarting, and they had extremely short steam cones with a diverging taper only. Your humble servant believes in following big practice wherever possible, so I adapted the idea to the little cone, and it gave equally good results, besides doing away with the need for making another cone reamer. Chuck a piece of 1/4-in. round brass rod in three-jaw, and turn down 1/2 in. or so to a bare 7/32 in. diameter,



Cones.

so that a 1/4-in. by 40 union nut will slide over it easily.

Turn down 5/16 in. of the end to a diameter which will just enter the bore of the injector a nice push fit. Centre, and drill down about 1/2 in. depth with a 65, 63, or 61 drill, according to the size used for the combining cone. Now turn a full 1/8 in. to a curved nozzle shape as illustrated, the tip being about 1/32 in. larger than the size of drill used. Put the 13/16-in. reamer in the tail-

stock chuck, and ream the end of the nozzle a shade, so that it is almost a knife edge, like a punch. Part off at $13/32$ in. full from the end. Reverse in chuck, and open out the hole to a depth of $9/32$ in. with a $7/64$ -in. drill; skim off any burr, and the cone is complete. It is simply pushed into the "steam" end of the injector bore, and should enter the combining cone about $1/32$ in.

Delivery Cone

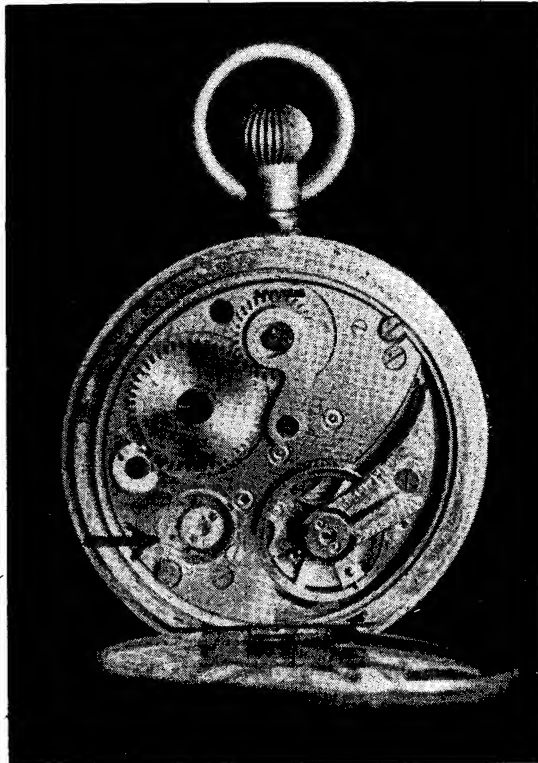
Chuck the $\frac{1}{4}$ -in. rod again, and turn the outside as described for the steam cone, except that the nozzle and parallel part are both $\frac{1}{8}$ in. long, and the curved nozzle is $5/64$ in. diameter. Face, centre, and drill down about $\frac{3}{8}$ in. with a 76, 74, or 72 drill, according to the size used for combining cone. Put the stubby reamer in the tailstock chuck and bell the nozzle to a knife edge. Part off at $11/32$ in. from the end. Reverse in chuck, and open out the hole with the finer tapered reamer until you can just see the extreme point at the bottom of the bell mouth. Round off the mouth slightly with the stubby reamer in the tailstock chuck, and face off any burr.

Air Valve

Drop a $5/32$ -in. rustless steel ball in the air release chamber, and set it on the reamed hole by putting the end of a bit of brass rod on it and hitting the other end one sharp crack with a hammer. To support jobs like these, I keep a round iron block about $\frac{3}{8}$ in. thickness with several holes of different sizes drilled in it. In the present case, the nipple under the injector goes into one of the holes, whilst the body rests on the block and takes the back thrust of the "biff," so that there is no fear of damaging anything. All we now need is a cap for the airball chamber; and to make this, chuck a piece of $5/16$ -in. hexagon rod in three-jaw, turn down a bare $\frac{1}{8}$ in. of it to $\frac{1}{4}$ in. diameter, screw $\frac{1}{4}$ in. by 40, make a countersink in the end to allow the ball a full $1/32$ -in. lift, and part off to leave a head $3/32$ in. thickness. Reverse and chamfer. As the chamber is open to the atmosphere via the overflow, no jointing material is needed on the threads. The cones are kept in place by the union nuts and collars on the steam and delivery pipes, and we will deal with those in the next instalment on fitting up the injector.

A Remarkable Watch

THE photograph here reproduced is of a pocket watch with a difference; that is, that the little pocket, marked with the arrow, holds a spare hair-spring, a top and bottom bearing cap and a little steel wedge. This watch had been in the possession of the owner for some considerable time before this unusual feature was discovered; now, a very close search is being conducted to find out if there is a secret



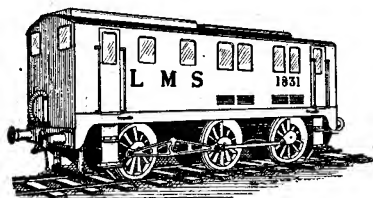
tool kit also hidden away in its depths.

Of course, the inevitable wit has suggested that a pair of 12-in. Stilsons and a spanner or two are yet to be found.

Nevertheless, the idea is good; one would appreciate spares carried in this manner if travelling abroad, as it is highly improbable that watch repairers in distant lands carry sufficient stocks to cater for all and sundry.—P. REEVE.

*Construction of Transmission Gear

By EDGAR T. WESTBURY



THE pressure disc and shaft (Fig. 117) may be machined in one piece if a suitable piece of steel—say, an old gas engine valve, or a forging of the required shape—happens to be available, or if one is he-man enough to enjoy turning it out of a solid bar. But the majority of constructors will probably find it more convenient to build it up by mounting a flat steel disc on a flanged shaft. The disc should first be bored centrally, and recessed out at the back, as indicated by the dotted lines. A shaft is then turned up between centres, with a spigot to fit tightly in the bore of the disc, and a truly faced flange, not less than $\frac{3}{4}$ in. diameter.

The disc may be secured to the flange of the shaft by means of six $\frac{1}{16}$ in. steel rivets (sixteen gauge soft steel wire is suitable) pitched on a circle of $\frac{5}{8}$ in. diameter; these should be well countersunk on both sides, so that their heads may be machined off flush afterwards. Alternatively, the disc may be brazed on.

* Continued from page 574, "M.E.," June 11, 1942.

The shaft is now mounted between centres and the outer face and diameter of the disc machined and the recess turned in the centre, also the parallel portion of the shaft turned to take the ball-races and screwcut at the end. As the ball-races will be clamped in position endwise, it is unnecessary to make them a press fit in the shaft, but they should on no account be too slack, or the disc may run out of truth.

It will be noted that a $\frac{1}{16}$ in. keyway is cut near the end of the shaft to key the coupling thereto. This should, for preference, be made to take a key of the Woodruffe or "half-moon" type, which affords the maximum strength for this particular job. The best way to cut such a keyway, assuming that the proper cutter is available, is to mount the shaft *vertically* in a machine vice held on the lathe cross slide, packed up to bring the required portion of the shaft up to centre height. In order to avoid visibility of the work being interfered with by the disc, the vice may be set at the rear end of the cross slide, so that the work is behind the cutter. Care should be taken to cut the keyway squarely in the centre of the shaft.

The cutter for this purpose should be not larger than $\frac{5}{16}$ in. diameter, with the portion of the shank immediately behind cutting face $\frac{3}{8}$ in. diameter. It is fed in to

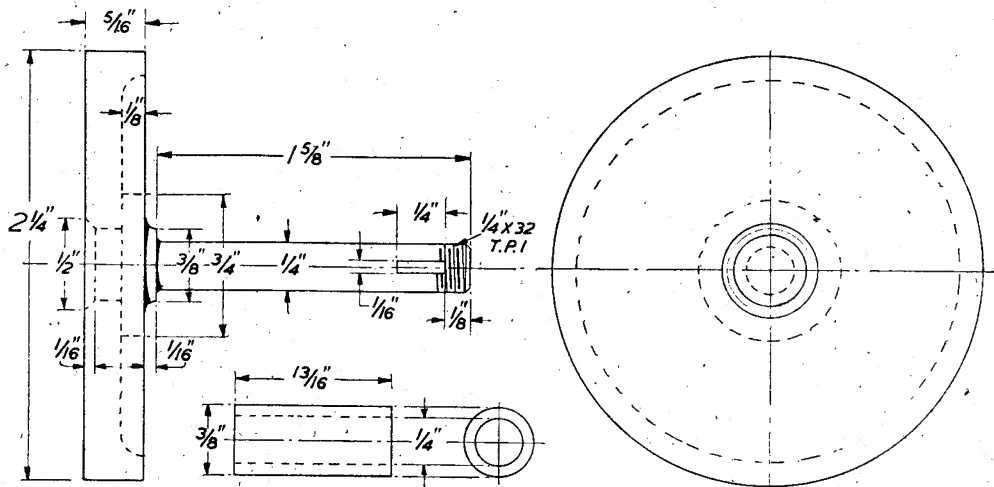


Fig. 117. Pressure disc and shaft, with ball-race spacing-bush.

the maximum possible depth. Such a cutter may be very difficult to obtain these days, but may be made fairly simply from a short length of silver-steel.

The spacing-bush, also illustrated in Fig. 117, is simply a sleeve of any convenient material, machined concentrically inside and out, and faced truly at each end. It is made a push fit on the shaft, and serves to clamp the two ball-races in proper endwise location.

Coupling. (Fig. 118)

Mild-steel is recommended for this component, though either good quality gun-metal or cast-iron, in order of preference,

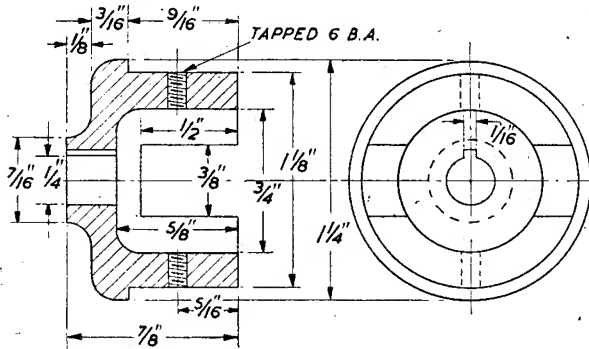


Fig. 118. Shaft coupling.

may be employed. It should be machined concentrically all over, the most convenient method being to mount it in the chuck, jaws outwards, to drill and bore the inside, face and turn the spigot, then reverse it and mount it on a true-running plug to finish the rest. Note that the jaws and spigot correspond with those formed integrally with the clutch housing on the engine shaft, and may, with advantage, be made identical in dimensions with same, but this is not imperative. The bore of the coupling should be a moderate driving fit on the pressure disc shaft, and the keyway either filed or planed to fit neatly over the shaft key.

The slots in the jaws of the coupling should be cut exactly square and parallel, also symmetrical about the centre line; errors in the latter respect will throw the

transmission shaft out of truth, and, therefore, out of balance, so that vibration and whip will be caused. End-milling methods may be employed to cut these slots, the work again being clamped, by a single bolt through the centre, to the vertical side of an angle-plate mounted on the cross slide. Incidentally, in view of the number of jobs which may, with advantage, be dealt with in this way, it would be quite a good idea to make or adapt an angle-plate specially for this purpose, boring a hole for the clamping bolt from the lathe mandrel, so that there is no possible doubt of it being exactly at centre height.

As there is a good deal of metal to be taken out of these slots, it would be a good idea to remove most of it by drilling, or by the use of a smaller cutter—say, 5/16 in. diameter—before finishing the sides with a 3/8-in. cutter. In end-milling in a light lathe, it never pays to attempt to rush matters by taking deep cuts; quite apart from the matter of accuracy and finish, light cuts and quick traverse usually result in quicker progress. The work, and any fixtures used to secure it, should be very rigidly clamped, and it is advisable to adjust the slides a good deal tighter than is usual for turning in order to avoid snatching and

digging in, which only too often results in spoiling work, cutters and temper.

Vertical Shaft. (Fig. 119)

Most of the work on this part consists of straightforward turning, which should be carried out between centres. It may be made from 7/16 in. diameter bright mild steel, providing that the ends can be centred perfectly truly, by holding one end in the chuck and supporting the other in a 3-point steady, or in a steady bush held in the tool post. If, however, it is impossible to ensure exact truth of the drilled centres, it will be best to turn the shaft all over from larger material, as it is most essential that all parts of it should run truly concentric. The main diameter should also be perfectly parallel and smooth, so that the friction-disc can slide along it freely, but with no

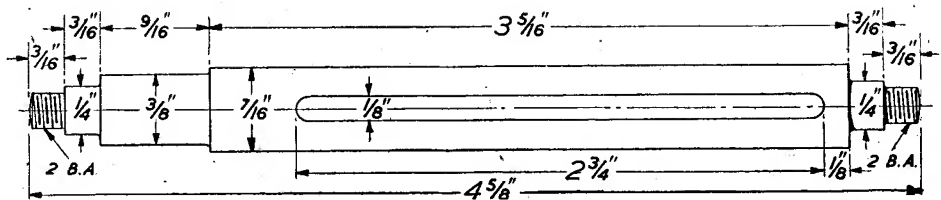


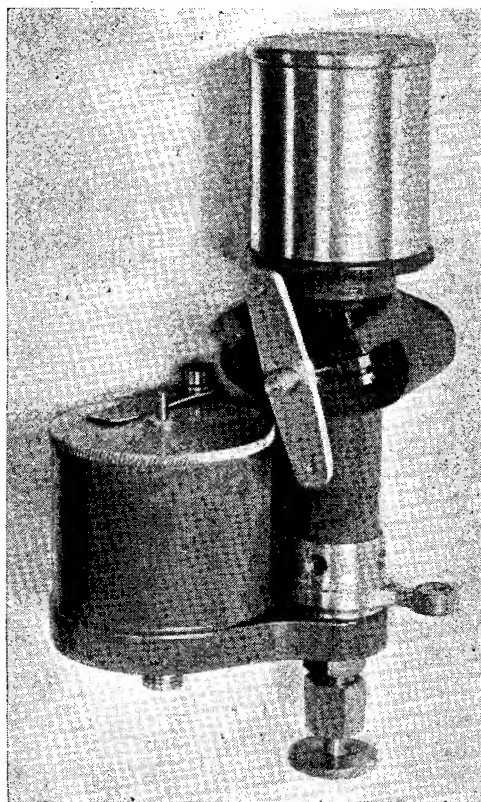
Fig. 119. Vertical shaft to carry friction-disc.

perceptible play, from one end to the other.

It will be noted that the ends of the shaft are turned down to form seatings for the ball-races, and also screwed to take nuts, by which the races are clamped in position. These portions must also be machined with due care so that the entire assembly runs truly when the races are fitted to the shaft housings; the seatings should fit in the races neatly, though not necessarily very tightly, in view of being equipped with clamping nuts. The latter should, for preference, be fairly tight on the threads, so that they are not liable to slacken off when the shaft is running; it will not normally be found necessary to fit any other form of retaining device if this precaution is taken.

The long keyway in the shaft may be cut by end-milling, and for this operation it may be held in the lathe tool post at right-angles to the mandrel axis, with a vee-grooved packing block under it, and packed up so that its centre is exactly coincident in height with the lathe centres. An alternative method, and one which I prefer for work of this nature, is to clamp the shaft to the *side* face of a bar having a vee groove along its length, exactly at centre height; this avoids the necessity for adjustment by packing, for any diameter of shaft within its capacity. The vee groove in the bar may be produced exactly in the right position by means of a short, rigid flat drill, with the lips ground to an inclined angle of 90 deg., held in the lathe chuck. To secure the shaft to the bar for cutting the keyway, small stirrup clamps are most convenient, but any clamping device which does not take up too much room in front of the work will be found suitable.

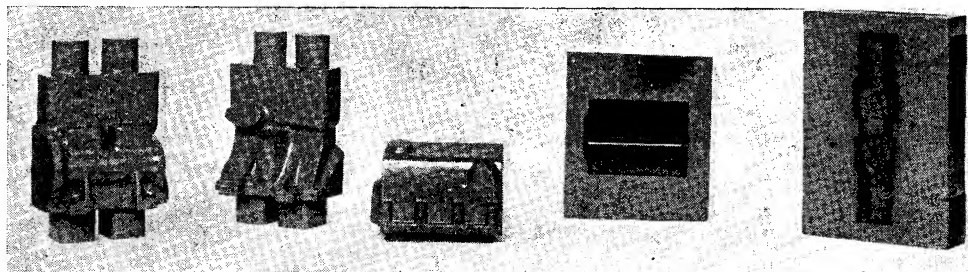
As an alternative to end-milling, the keyway can be cut by means of a side cutter such as an ordinary slotting or Woodruff key-seating cutter, but in this case it will be necessary to allow for the run-out of the cutter at the ends, by making the keyway a little longer, or by shaping the ends of the key to suit. The key, which should be made from a good quality, tough grade of steel,



Carburettor for "1831," made without castings, by Mr. Ian Bradley.

should extend the full length of the keyway, and should be fitted to drive firmly into it, but not so tight as to distort the shaft in the process. Take care that no burrs are left on the shaft or the key after fitting.

Incidentally, it may be remembered that in THE MODEL ENGINEER Road Roller transmission gear, I specified a *square* shaft for the sliding friction disc. Many constructors, however, either encountered or anticipated some difficulty in the fitting of an internal



Patterns and coreboxes for main casting and sump of "1831" engine, made by Mr. C. Sandham, of Fleetwood.

and external square in an assembly required to run dead truly, and therefore used a round shaft with a long keyway, much as described here. While I am still of the opinion that the square shaft would provide the more robust form of drive for this particular duty, there is no doubt that the key is capable of standing up to the work if properly fitted; a better arrangement still would be a multi-splined shaft,

and sweating (or silver-soldering) a sheet brass disc to a shouldered hub. In either case, the component should subsequently be machined all over to run dead truly, and bored to a neat sliding fit on the vertical shaft. It is best to cut the keyway by means of a planing tool in the lathe; if this is made exactly the same width as the key in the shaft, and set correctly at centre height, no further fitting should be found necessary.

The friction-disc cover-plate, shown in Fig. 121, is simply a flat washer, which may be machined in a single operation from a square piece of $\frac{1}{8}$ -in. sheet brass tacked to a wooden disc mounted on the faceplate. A cut should be taken across the face of the disc before mounting the sheet of brass on it, which may be done by means of four small nails or screws in the corners. Bore the centre hole first to fit neatly over the spigot of the friction-disc, then skim the face and turn the bevelled edge; finally trepan out to the required diameter with a narrow parting tool. Apart from cleaning off the burrs, the plate should need no further treatment, so long as it was reasonably flat on the inside face to begin with.

Slip the cover-plate over the spigot of the disc, after marking out the positions of the screw holes, and clamp it lightly at the edges while drilling the holes in both members. The screws used for clamping

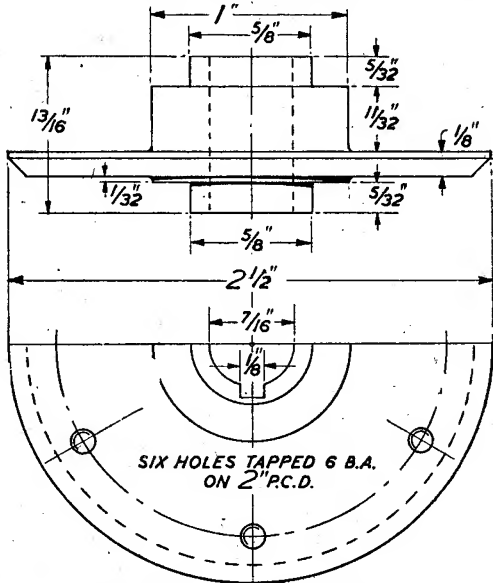


Fig. 120. Body of friction-disc.

but this presents great difficulty to the constructor with limited equipment. It would, however, be possible to fit two or more keys, located at equal intervals around the shaft, if any doubt should be felt as to the capacity of a single key to carry the load without undue wear. I may, however, mention that only in the event of impact load, due to excessive backlash, being imposed on the key, is it likely to give any trouble.

The provision of a keyway in the $\frac{3}{8}$ -in. diameter portion of the shaft, for securing the gear pinion, is optional, but it is not specified in the drawing. As a matter of fact, it will be found quite satisfactory to press the gear on the shaft and drill a cross hole through both to take a well-fitted pin. It is not an easy matter to fit a key really nicely to a boss having so small a bore as $\frac{3}{8}$ in., and a badly fitted key is worse than no key at all.

Friction-disc. (Fig. 120)

This may be produced in one piece, from a gunmetal casting or other available material, or it may be built up by pinning

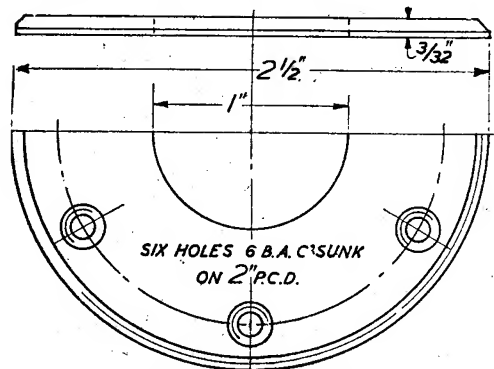


Fig. 121. Friction-disc cover-plate.

the friction material need not necessarily be exactly the size specified; in fact, soft copper rivets might be used for this purpose, but in any case the heads must be counter-sunk, and the tails must not project to any appreciable extent either—which, in the case of rivets, amounts to countersinking both sides. This precaution is necessary to avoid the risk of fouling the shifting fork plates which embrace the sides of the disc hub, with only $\frac{1}{32}$ in. clearance over the sides of the cover-plate and disc respectively.

The material employed to provide the actual friction surface of the disc should preferably be bonded asbestos fabric, such as Ferodo, though there are many other materials which might be utilised more or less successfully. In THE MODEL ENGINEER Road Roller, compressed cork (in the form of small circular table mats) was recommended, and proved generally satisfactory, but it does not wear quite so well as the asbestos fabric, especially in cases where heat is generated by friction. As it is to be expected that this locomotive will have to do a considerable amount of manoeuvring, the more durable material will probably be found to give the best service.

Ferodo, and similar compositions used for clutch and brake linings, may be obtained in moulded discs of various sizes, and it is proposed that one of these should be used here if available. The size of disc required is $2\frac{3}{4}$ in. diameter by $3/16$ in. thick, with a 1-in. hole in the centre, but should the last-named dimension fail to correspond, it is of course possible to modify the diameter of the hub spigot to suit. The advantage of using a moulded disc is that it is only necessary to drill the screw holes in it, and, after assembly, to run the disc on a mandrel in the lathe for rounding off the outer edges with glass-paper.

In the event of not being able to obtain a disc of suitable size, however, it may be

cut from $3/16$ -in. thick sheet material, leaving an allowance on diameter for finishing. Sandwich the material between the disc and cover-plate, mount truly in the lathe, and trim the outer edge to shape by means of a point tool. Asbestos fabric is queer stuff to turn, and the tool will leave a very ragged surface, but subsequent use of a file and glass-paper will smooth it sufficiently for practical purposes. The surface will tend to glaze as a result of use, which is all right so long as it does not pick up oil or grease; the latter, if encountered, may be removed by light application of a file-card while the mechanism is running.

Should the disc run out of truth either sideways or concentrically when assembled, it may not necessarily affect the driving efficiency very much, but apart from the matter of appearance, the result would be to produce cyclic variation of speed—or in words perhaps more generally comprehensible, “syncopated rhythm.” This effect may be regarded as comparable to what happens when a gramophone record runs out of truth. I doubt whether even the most “modern” devotees of model engineering would approve of a locomotive which proceeded along the track in a kind of “hesitation one-step”!

(To be continued)

Letters

“Beautiful Round Knobs”

DEAR SIR,—In the May 21st issue of THE MODEL ENGINEER your contributor, Mr. A. L. Steels, in his article, “An Improved ‘M.E.’ Capstan Attachment,” mentions his difficulty in obtaining “beautiful round knobs” for the windlass handle.

He would have found the very thing in any yacht chandler's in the form of “parrells.” These are lignum-vitae balls with a hole through the diameter and are stocked in various sizes from about $\frac{1}{2}$ in. to 2 in. diameter. The hole in the 1-in. size is usually about $\frac{1}{4}$ in. These balls polish “beautifully” and, invariably, have very handsome figuring.

Yours truly,

Glasgow,

JAS. TOPPING.

Traction Engines

DEAR SIR,—With reference to the photo. of a Fowler traction engine, class “B5” type, which appears on page 512 of THE MODEL ENGINEER dated May 28th, you state that traction engines are seldom found on the roads these days and ploughing and

threshing are their principal duties. As I have a large collection of steam tractor photos. (about 700) I thought I might add a few remarks about same. At present, there are 15 Showman and other types working in the City of London, pulling down the large buildings which have been bombed. There are Fowlers, Burrells, Foster & Garretts, and all the engines have been at work a number of years. Most of these were driving and lighting such things as Galloping Horses, Scenic Railways, and Dodge'ems. I have also seen these engines in many more towns on this kind of work, also sawing wood, hauling three trailers on the road and lighting emergency hospitals. I have tried to explain what these engines are doing at present, and, as petrol gets shorter, we shall see more of these fine road locos. about, as there are dozens stored in showmen's yards around the country, the reason being that the Diesel tractor has taken their place. When a showman gets into a bad field he always sends for a spare engine to pull his loads out. Firms such as M.R.S. Ltd., Pickfords, Rudd & Co. Ltd., Coulson & Co. Ltd., still have fine fleets of these engines hauling large loads up to and over 100 tons.

I have at home in London a model of a Burrell showman's type under construction

to scale of 2 in. to 1 foot. Also, with me in the Army, I have a small Fowler type loco. 7 mm. under construction. This was started when I joined up in February, 1940, and has been made of scrap brass which I have picked up where I could. I am putting as much detail in as space will allow. It is beginning to look quite smart now, but you will appreciate that I do not get a great deal of time for doing this; but every spare minute goes into the model, and I find it helps the war along and keeps my mind off it also. Some jobs, like wheels and some fittings, had to be made at home on the

lathe, as one just cannot take a lathe around. Not only do I take a grinder, but nearly all my small tools around with me. Of course, I also have to do small jobs for some of the lads, like repairing lighters and so forth, but I enjoy it just the same. When the Fowler 7 mm. is finished I'll send a photo. along with a few lines to describe it. I manage to obtain the "M.E." every week and always look forward to Thursday; I wish it every success.

Yours faithfully,

O.A.S.

PTE. A. C. DURRANT.

Clubs

The Kent Model Engineering Society

As already mentioned, the meetings of the Society will be held in future on Tuesday evenings at 7.30, at headquarters at Sportsbank Hall, Sportsbank Street, Catford, S.E.6, instead of Sunday mornings as in the past.

On June 30th Mr. Davidson will lecture on "Making a Small Lathe."

During July the Society will operate the track and locos. on three different dates, in aid of various fêtes; particulars later.

Hon. Secretary: W. R. COOK, 103, Engleheart Road, S.E.6.

The City of Bradford Model Engineers' Society

Future meetings of the above society are: July 2nd, 1942.—At the Channing Hall, 7.30 p.m. This will be an open meeting.

July 19th, 1942.—At the Channing Hall, 10.30 a.m.

Mr. D. Birchall will give a talk on Model Aeroplanes. Mr. Birchall is quite an authority on this subject, having successfully built and flown a few power-driven models.

Hon. Secretary and Treasurer: G. BOWER, 33, Moore Avenue, Wibsey, Bradford.

The Society of Model and Experimental Engineers

There was a smaller attendance than usual at the Informal Meeting held in The Workshop on Wednesday, 10th June, 1942. The following were elected to membership: Mr. R. Cadman (Goodmayes), Mr. R. T. Heathcote (Waltham Cross), Mr. T. F. Maw (Golders Green), and Mr. C. A. Smith (Winchmore Hill). It was announced that the Society were supporting a scheme for the presentation of a chronometer to a British Warship, and also that a proposal was being examined under which members of the Society would undertake the repair and maintenance of small arms for the Home Guard.

The next meeting will be held at The

Caxton Hall, Westminster, on Friday, 10th July, 1942, and the 9th series of Lecturettes by Members has been allocated to this date.

Secretary, H. V. STEELE, 14, Ross Road, London, S.E.25.

Altrincham Model Power Boat Club

For the past few months our meetings have been held at the Lakeside instead of indoors, and they have proved very successful. Members have turned up well, some with new boats, others with their "Trusty Steeds" well known to power-boat fans. The next meeting will be held at the Lakeside, Lindow Common, Wilmlows, on Sunday, June 28th, at 2.0 p.m. All power-boat fans are welcomed to our meetings.

Will readers please note the change of Hon. Sec. and his address.

Hon. Sec., NORMAN C. COLEMAN, "Fairholme," Stanley Mount, Brooklands, Sale.

York City and District Society of Model Engineers

The next meeting will be held on Friday, July 3rd, 7.30 p.m., at The Bay Horse Hotel, Monk Bar. Will all members attending bring something of interest.

Hon. Sec., H. P. JACKSON, 26, Longfield Terrace, York.

West Midlands Model Engineering Society (Wolverhampton Branch)

The next meeting of the above Society will be held at the Red Lion Hotel, Snow Hill, on Wednesday, July 1st, at 7.30. Friends and visitors are cordially invited.

Hon. Sec., F. J. WEDGE, 13, Holly Grove, Penn Fields, Wolverhampton.

NOTICES.

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co. Ltd., Cordwallis Works, Cordwallis Road, Maidenhead, Berks.

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," Cordwallis Works, Cordwallis Road, Maidenhead, Berks.